SERVICE-ALIGNMENT-OPERATION INFORMATION

FOR THE

SSB TRANSMITTER

MODEL HX-10

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BENTON HARBOR,
MICHIGAN

PREFACE

It is the purpose of this manual to provide additional detailed service, alignment and operational information in connection with the Heathkit "Marauder" SSB Transmitter, Model HX-10. Although impractical to include such information in the construction manual, the following will give the kit builder a greater degree of understanding with which to solve normal servicing, alignment and operational problems. The material is arranged to parallel the construction manual beginning with Page 101.

SERVICE INSTRUMENTS

1. A VTVM with regular isolation probe (usually 10 megohms or greater) is required for DC voltage measurements. All meter readings may vary within small limits depending on the individual meter used.

2. The same VTVM with RF Probe should be used for RF measurements. (In the case of this probe, be sure that the diode element is in good condition since this can cause low readings when used with the best of meters.) Diodes are easily damaged by high voltage DC measurements.

3. A good communications receiver, preferably providing general coverage, with a 100 kc crystal calibrator is ideal for alignment purposes.

   a. For purposes of alignment it may be necessary to couple the receiver antenna to the Driver stage, V8, using a length of insulated wire wrapped around the tube.

   b. If the receiver is capable of receiving the VFO frequency direct (4900 to 5500 kc), it may be desirable to couple the receiver antenna during VFO alignment to the VFO buffer stage, V12, using a length of insulated wire wrapped around this tube.

   c. After transmitter alignment, it is important that the receiving antenna be shortened (only a stub a few inches long suffices) before attempting carrier null and sideband adjustments. With the receiver RF gain control full on, the receiver "S" meter should just read full scale with full transmitter output being delivered to a dummy load in the CW mode. If the receiver "S" meter reads over full scale, the receiving antenna should be shortened still further until it reads just full scale. When changing from CW to the SSB mode at the transmitter and adjusting the Carrier Null controls, an approximation in db of the amount of suppression will be indicated on the receiver "S" meter. The accuracy of such reading will depend on the accuracy of the receiver "S" meter calibration.

4. A good Audio Generator with variable metered output amplitude near a 30 millivolt level in the audio range from 300 to 2000 cps will be found most useful in the accurate setting of the carrier oscillator frequency. Those builders not having this instrument may still obtain an approximately correct setting by closing the carrier oscillator trimmer, C80, physically to the position shown in Figure 28 (Page 119) of the construction manual. Since the range of this trimmer is narrow, this setting should be within ±75 cps of the correct frequency.

SERVICE INFORMATION

(Refer to Schematic and Construction Manual.)

1. Initial inspection and checks:

   This check, beginning on Page 107 of the construction manual, is designed to prevent serious wiring errors to the transmitter which could cause permanent damage to the cable harness and components, if left un-

detected. As such, it is urgently recommended you obtain normal ohmmeter readings in this section before proceeding further. The note at the top of the right-hand column, Page 101, is to be properly considered a part of this resistance check.

a. Resistance measurement of each side of the line cord to chassis ground should indicate infinity (or an open, ungrounded line). If any resistance lower than 100 megohms is indicated, bypass capacitors C134 and C135 should be suspected of leakage or the miswiring of primary AC leads may have occurred. The color-code of these leads to terminal strip FJ is black-orange and black-white. They exit at lugs 5 and 1 of terminal strip FE, respectively.

b. Resistance measurement of Diodes CR5 and 6 with proper polarity observed will indicate these diodes are wired in circuit correctly. If they should be reversed, resistors R107 and R108 will become overheated and damaged due to excessive current being drawn through them. If such condition exists long enough, it is also possible to permanently damage the bias winding of the transformer. If the diodes are properly wired in circuit, too low a resistance reading can indicate a possible grounded bias line to V6A, V8 or V20 and V21. Check the grids of each stage. The only correction for reversed diodes is to rewire them properly in the circuit. Bad diodes should be replaced.

c. Resistance measurement at lug 8 of V14 (5U4) to ground should indicate approximately 18 K for a correctly wired unit. If a lower reading occurs, there is the possibility of a short circuit. If a higher reading occurs, this may mean one of the B plus lines is not connected. This circuit may be checked by lifting the lead from Choke L17 to pin 8 of V14 and again making a resistance measurement. If further tracing is necessary, the white-red lead to capacitors C136A/B may be lifted and again checked. If low resistance is still indicated, the four white-red leads at lug 5 of terminal strip FY may be lifted one at a time. Terminal points where these leads exit are DH lug 4, BF lug 5, AZ lug 4 and AG lug 1. Correct the short circuit in the indicated line, replace all disconnected leads and make the original measurement as a double check before proceeding.

d. Resistance measurement at lug 8 of V13 (5R4) to ground should indicate approximately 180 K ohms for a correctly wired unit. This circuit may be checked by lifting the heavy blue lead from Choke L16 to lug 2 of terminal strip AT and making a resistance check. If still low, the heavy white-blue lead at lug 1 of terminal strip GD may be lifted and again checked for resistance. Note that C104 must be mounted on an insulated wafer and C105 is mounted on a metal wafer. Check the connections and proper resistance of R53 and R54. If low resistance to ground persists, the heavy blue wire at GD3 which passes through the side wall of the chassis to Choke RFC-6 in the amplifier compartment may be lifted and checked. The remaining components C75 or C76 may then be checked directly for internal short circuits. Correct any errors, replace all leads and make the original measurement as a double check before proceeding.

2. Accessory Socket:

Lug 1 - 1 megohm to ground. Color code white-brown-brown, exits at lug 1 of R110 (Anti-trip control on front panel).

Lug 2 - 1 to 3 ohms with relay K in Transmit position (close manually). Varied by setting of R119 (Mon. Level control on top plate). Color code white-yellow, exits at lug 12 of relay K.

Lug 2 - 22 ohms with relay K in Receive (normally open) position. (Represents resistance of R59).

Lug 3 - 22 ohms. Color code white-blue, exits lug 11 of relay K (relay K open or closed) represents resistance of R59.

Lug 4 - Infinity - relay K in Transmit (close relay manually). Color code

white-yellow-orange, exits at lug 4 of relay K.

Lug 4 - Zero ohms - relay K in Receive position (normally open). Represents ground connection at lug 5 of relay K.

Lug 5 - Zero ohms - relay K in Transmit position (close relay manually). Color code white-violet, exits at lug 3 of relay K and R75.

Lug 5 - 100 K - 120 K ohms - relay K in Receive position (normally open). Represents resistance of R75 plus series resistance to ground through the bias supply.

Lug 6 - Zero ohms - connected directly to chassis ground.

Lug 7 - Infinity - color code black-white band (represents common side of the AC line). Exits at lug 1 of terminal strip FE.

Lug 8 - Infinity - color code white-gray (represents interrupted side of AC line). Exits at lug 10 of relay K.

RF Output Connector - 11 K ohms to chassis ground (represents resistance of R57 and R58).

Phone Patch Input - 1 megohm (represents resistance of R1).

Receiver Spotting Signal - infinity (represents capacity stub only - no DC path to ground).

3. Initial Test and Adjustment:

In this check both V13 (5R4) and V14 (5U4) are removed from their sockets so that only filament and bias voltages will be present when changing the Function Switch from OFF to STDBY.

a. In plugging the line cord into the 117 V AC receptacle (Function Switch OFF), 117 V AC should appear between lugs 1 and 5 of Terminal Strip FE. This represents the AC line voltage.

b. Since the primary of T1 is permanently connected to the same lugs, 6.3 V AC should appear between the secondary of T1 at lug 1 of terminal strip FC and ground. This represents VFO and Buffer (V11 and 12) filament voltage which should be evident by observing the filaments of these two tubes on the VFO chassis. Since there is little chance of miswiring connections to T1, any defect in the operation of the filaments of V11 and V12 will have to be investigated inside the VFO enclosure. Both red and green leads should be disconnected under the chassis. It should be simple to make an ohmmeter check of the filament wiring to tube pins 3 and 4 (tubes out of their sockets), correct the error and remount this unit. Make the 6.3 V AC measurement check called for previously, then proceed.

c. Function Switch in STDBY - All other tube filaments (except V13 and V14, which have been removed) should now light and negative bias voltage of 150 V DC should appear at lug 1 of terminal strip FX.

1. Physical inspection of tubes for lack of filament power would be quick and simple. If an unlighted tube is observed, be sure to check its filament connections and voltage at the tube socket terminals. A check for grounding of any part of the filament line was previously done on Page 101 of the construction manual. The filament lines originate in the three white-brown leads on lug 4 of terminal strip FE and can be lifted, one at a time, to eliminate any short circuit which might exist.

2. -150 V DC bias voltage at lug 1 of terminal strip FX. Color code white-gray, exits at lug 1 of terminal strip FH. Lack of normal bias voltage here would be caused by diodes CR5/6 being reversed in polarity, defective diodes, a short in some portion of the bias line, capacitors C138A/B being reversed in polarity, or improper wiring to any one of the resistance divider legs connected in parallel across this circuit. Check resistance between legs and to ground of R101,

R76, R86, R87, R89, R90, R96, R91, R93, R94 and R75. Refer to Pictorial 16 of the construction manual for wiring check. Color codes to these terminal strips are as follows:

FV, Lug 2 - white-yellow, exit R111-1 (Spot Level).
FV, Lug 4 - white-gray-green, exit lug 1 terminal strip AH.
FV, Lug 5 - white-violet, exit lug 3 relay K.
FW, Lug 1 - white, exit lug 3 terminal strip BD.
FW, Lug 5 - white-gray, exit tube V18, lug 7.
FX, Lug 2 - white-green, exit FS1-11 (Function Switch).
FX, Lug 2 - white-green, exit lug 2 terminal strip DL.
FX, Lug 2 - white-green, exit lug 4 terminal strip DR.

3. The bias check is not complete unless -140 V DC can be measured at lug 5 of V20 and V21 and -68 V DC at lug 7 of V6A and lug 2 of V8. Bias for V20-21 is taken from R96, color code white-gray, exit lug 2, terminal strip BD. R38 is connected from BD2 to BD4. Color code at BD4 white-green with exit at DU5.

   FX, lug 4 - white-gray, exit lug 2 terminal strip BD.
   Bias for V6A, lug 7, and V8, lug 2, is taken from the junction of R86 and R87, lug 2 of FX. Color code white-green, exit to V8, lug 4 of DR.
   Exit to V6A, lug 2 of DL. Trace each, correct, then proceed.

4. Initial Voltage Checks: (Bias and Low Voltage applied)

   In this check, since the 5U4 (V14) is now reinstalled, both bias and low voltage will be applied to the unit. If previous resistance measurements check satisfactorily at the rectifier socket, then this step may be taken with confidence that no direct short circuit should be encountered.

   a. When turning the Function Switch to STDBY, the filament and bias voltages previously checked should again reappear and, in addition, a voltage of +325 V DC should be measured between lug 5 of terminal strip FY and ground. A reading at lug 1 of FY should be +150 V DC.

      1. Since the resistance measurements given in the paragraph on Initial Checks covered the white-red leads to both FY1 and FY5, the same terminating points may be used for voltage checks, namely, DH4, BF5, AZ4 and AG1.

   b. Prior to RF measurements at the center arm of R118 (carrier null potentiometer on top plate) and R117 (sideband balance potentiometer on top plate), R118 is rotated fully clockwise and C80 is rotated to its mid-range (50%) open position. C80 will raise or lower the RF voltage available at lug 2 of R118.

      1. A VTVM RF reading (with RF probe) at this point should read at or near 2.7 volts. This reading can vary between 2.0 and 4.0 volts RF and still give satisfactory results. If, however, this voltage is less than 2.0 volts, it may become marginal in producing output sufficient for adequate heterodyne action. If after checking the following Steps 2, 3, and 4 this RF voltage remains too low, then carrier oscillator crystal Y1 should be replaced.

      2. Lack of sufficient voltage at R118-2 can also be caused by defect or miswiring of C84, R43, R44, C82, C83 and MS5. Correct any error, obtain proper voltage and proceed.

      3. Low RF voltage at R118-2 can also be caused by miswiring of R9 and R10, C9 and C9A or improper installation of wiring to diodes CR1 and CR2. Correct wiring and proceed.

      4. Never overlook the fact that a bad tube could be the culprit. Replace and proceed.

      5. Inability to tune the Carrier Oscil-

lator should be traceable directly to the wiring of C80. Correct and proceed.

c. In making the RF measurement at the center arm of R117, the 13,990 kc LSB oscillator is keyed through Mode Switch section 4 (MS4) for all modes except USB. In order to measure USB oscillator voltage, it is necessary to change the Mode Switch to USB. The readings in both modes are varied by R117 and should be made initially about equal in amplitude.

1. It should be possible to obtain an RF voltage reading (VTVM with RF probe only) near 0.6 volt or more on both oscillators (always measured at the center of R117). This value can, however, vary within small limits (±15%) and still produce satisfactory results.

2. If there is no output from the LSB - USB oscillators, check the bias voltage to each one first to determine if one is being keyed through MS4 and isolation resistors R99 and R100. The source bias voltage for these oscillators is taken from the junction of R93 and R94. Color code white-gray-green at FV4, exit AH1. There should be no bias applied to that oscillator which is in operation. Check tube wiring, all ground connections and plate voltage. Check Mode Switch wiring at MS4 for error. Check for defective tube - replace if necessary. Check crystals Y2 and Y3 for activity with VTVM and RF probe at R117, lug 1 or 3 (each should read well over 1.0 volt).

d. Adjustment of Heterodyne Oscillator Voltages: Use the regular VTVM probe for this measurement (not RF probe), inserted in test point TP (see Figure 22 of the construction manual). Connect the common meter lead to chassis ground.

1. Using the chart on Page 109, set the heterodyne oscillator voltages as shown. It is recommended you turn each coil slug counterclockwise until the oscillator stops oscillating. Then turn each slug clockwise until the proper indicated chart voltage is reached. (Note these oscillators have two points at which they will show the correct voltage. One side is slow to change, broadly tuned and easily set. The other side is sharp and somewhat unstable. The first is the correct side.) The procedure outlined above is designed to maintain this adjustment on the proper side of the coil tuning range.

2. Any difficulty with this stage (V6B) can be traced on the grid side to Bandswitch segment 1 (BS1) and on the plate side to BS3. Check all connections to the coil bracket including by-pass capacitors C95 and C103. Check wiring of C93 and resistors R49 and R50. Be sure crystals Y4 through Y9 are in their respective sockets and that the base pins are making good contact. Check plate voltage at lug 3 of this stage. Each should start reliably when the bandswitch is rotated from its "6.9" to its "29.1" position.

3. Heterodyne Oscillator voltage is coupled from V6B to V6A through capacitor C18. This may be easily checked for short circuit by an ohmmeter check. A short here, however, would place B plus on the bias line and would have shown up in the previous bias and power checks.

5. VFO Calibration

Note that two methods to calibrate the VFO are offered. One is by listening directly to the VFO frequency (4900 to 5500 kc), in which case it is necessary to couple the receiving antenna to V12. The other method is by listening to the driver output frequency (V8), in which case it will be necessary to couple the receiving antenna to V8. In the second method, remember that the mixing action of the transmitter has not yet been tuned on Page 113 and calibration should be delayed until the 3.5 mc section has been tuned, using the first step in the chart on Page 116 of the construction manual. In this event, the VFO RF

voltage as read at lug 1 of tube socket V7 (3rd step, left column, Page 115), may appear somewhat different than listed.

a. For servicing internally, it is necessary to remove the VFO from the chassis. The VFO may be checked on the bench by applying the 6.3 V AC filament voltage and +150 V DC plate voltage to it from an external power supply. The green and red lead plus coaxial cable are the only connections to the unit using the chassis as common ground. A 47 KΩ resistor may be tacked across the coaxial output cable to simulate the transmitter load circuit in this test.

b. All wiring to tube pins of V11 and V12, as well as the XTAL-VFO Switch, should be checked. Components C121, C122, C123, C124, C125 and C126 should be examined for cold solder joints. Check all ground connections. Check plate and screen voltages to V11 and V12. Check by-pass capacitors C151 and C96 for proper connection. A similar wiring check of V12 should be made. A VTVM with RF probe may be connected to the coaxial cable and load resistor for a normal RF voltage check near 1.2 volts. Check operation of XTAL-VFO Switch before reinstalling this unit. RF output voltage should disappear with this switch in the XTAL position. If wired according to the step-by-step instructions and schematic, little difficulty should be experienced with this unit.

c. In the mechanical adjustment, Step 8, left column on Page 114 of the construction manual, it should be pointed out that in order to arrive at a point where calibration is to begin, the plates of tuning capacitor C123 are first fully meshed. A clockwise rotation of the worm gear seven turns into the fiber gear meshes the two accurately and keeps the worm gear high point (the point opposite the setscrew) away from the fiber drive gear, thus avoiding any "out-of-roundness" contact at this point. In the 10th Step, left column of the same page, the worm gear is now turned nine turns counterclockwise. Since it is now meshed with the fiber gear, it opens the capacitor plates, micrometer fashion (after observing full mesh in a receiver), approximately the proper amount open before beginning the calibrating process. Lack of properly performing this step results in poor tracking of the VFO with the front dial plate.

6. Intermediate Test and Adjustment:

a. In obtaining the VFO voltage at lug 1 of V7, note that the Drive Level control must be set fully counterclockwise. This prevents any IF voltage from entering at the VFO Mixer to change this reading. Since only the VFO is involved, lack of an RF reading here indicates the VFO is not functioning or the Frequency Control Switch is in XTAL position, with no crystal in the VFO socket. VFO repair was previously discussed in Paragraph 5 of this manual.

b. Initial IF Transformer Alignment: (made with VTVM and RF Probe)

Since the VFO is disabled by turning the Frequency Control Switch to XTAL position with no XTAL in its socket, and the Drive Level control is set fully clockwise, while the bandswitch is set in 3.5 mc position, it follows the only RF voltage present at lug 1 of V7 is IF voltage. Although the Function Switch is in STDBY position, the key must be closed to take the reading in order to remove the bias from the Heterodyne Mixer stage. (T3 and T4 are supplied preset so that large excursions of their tuning slugs are not necessary. Doing so will unnecessarily complicate the tuning of T3 and T4.) After peaking both slugs in T3 and T4, an RF peak reading of 0.8 volt should be realized.

1. If this voltage seems low, move the SB balance control R117 slightly to observe if enough voltage is available. Carrier Oscillator Trimmer C80 may also be moved to increase this reading at this time. This voltage should be fully controllable by rotating the Drive Level control.

2. If unable to tune this stage, a thorough recheck of the wiring to V5 as

well as T3 and T4 should be made. Plate and screen voltage of V3 and V5 should be checked. Check the ground connection of T4 to the chassis as well as those at the tube socket.

3. If the Carrier Oscillator voltage was normal and the Sideband Oscillator is functioning properly, these two signals combine at lug 7 of V3, the Sideband Mixer. The RF level here, however, would be only about 0.3 volt RF. Again, do not overlook the possibility of a bad tube at V3 and V5. Replace, if necessary.

7. Alignment (See Chart, Page 116)

Entering this phase of work, it must be assumed that near normal RF voltages have been obtained at the Carrier Oscillator, Sideband Oscillator and IF Amplifier output. Each of these have been treated separately. It is also assumed that the VFO has been calibrated and you are able to tune the transmitter and receiver (with shortened antenna) to the frequencies indicated. The absence of any one of the previously mentioned signals would result in no driving voltage being delivered to the Driver or Final Amplifier stages.

a. Using the Receiver "S" meter, Driver Tuning Capacitor set as marked, the VFO Mixer and Driver Coils should be tuned to a peak receiver "S" meter indication. On the 3.5 mc band, this should result in grid current being indicated on the Transmitter grid meter. If it should read full scale, keep reducing the Drive Level control to keep the meter pointer on scale. On this scale, remember the meter indicates from 0 to 1 ma. (Note that in class AB1 operation, zero grid current allows full output power in SSB. Only a small amount of grid current is used in the CW mode to improve the efficiency.) If no grid current is indicated, peak T3 and T4 while watching the receiver "S" meter again. If no grid current is indicated examine coils L6 and L11 and determine if they have the proper capacitors C44 and C55 installed. Examine C40A and C146 for proper installation. Trace the color coded leads of these coils to determine if they are properly connected to BS4R3 and BS5R3, respectively. Check plate and screen voltages of V7 and V8. Check ground and bypass connections at these two sockets. RF voltage measured at the grid of V8 (with RF probe only) while peaking the Driver Tuning Capacitor should be near 6.0 volts. RF voltage at the grids of V20-21 should be near 40 to 45 volts on this band. If grid current is still absent, check V20 and V21 for grid shorts. Check R36 for a resistance reading of 6800 ohms. If this reads low, replace with a new component. Grid current will not be indicated on the front panel meter if a meter probe is left connected to the grids of V20-V21.

8. Final Amplifier Neutralization

Three methods are given. Two (VTVM and Grid Dip Oscillator methods) require that V13 (5R4) be removed from its socket. The maximum power, minimum plate current method requires that V13 (5R4) be reinstalled. Since transmitter tune-up, with or without this rectifier installed, may be unfamiliar as yet, reference to operating instructions on Page 130 may prove helpful here. If the RF voltage level is too low to read well in the VTVM or Grid Dip Oscillator methods, the dummy load may be removed from the output connector to give a slightly higher reading. In all cases, do not forget to replace the dummy load before tuning up with full transmitter power.

a. The most important items in the neutralizing network are as follows:

1. Correct length and placement of the neutralizing cable from C58 to DT4. (Keep it down against the chassis.)

2. The red lead from hole 24 to bandswitch lug BS5R10. (Keep it down against the chassis.)

3. The blue lead from BS5R10 to DT4. (Keep it down against the chassis.)

4. C146 must be located on the Driver Coil bracket as in the right-hand illustration of Detail 20B (Page 67).

5. C40A must be located on the VFO

Mixer Coil bracket as in the left-hand illustration of Detail 20B.

6. Neutralization should always be done at 14,250 kc with full grid current indicated. DO NOT attempt to neutralize if there is no grid current indicated.

b. Whenever Final Amplifier tubes are changed, always reneutralize again at 14,250 KC.

c. After neutralization, it is always wise to repeak all coils in the Chart on Page 116 in addition to transformers T3 and T4.

9. Final Alignment:

a. Initial Setting of Carrier Null

1. Initial carrier oscillator trimmer C80 setting should always be two-thirds closed. (See Figure 28, Page 119.)

2. The transmitter should be tuned for maximum power output in the CW Mode at 3800 kc on a dummy load.

3. The receiving antenna should be reduced to a stub (a few inches long) which will just give full scale "S" meter reading with the receiver RF gain full on (transmitter producing full output in CW Mode).

4. Place the transmitter mode switch in USB position, close the AF Gain control and key the microphone on or short mike pin 2 to ground. A carrier null in this position (even through some indication other than zero, but well down on the "S" meter scale, is present) is satisfactory for this initial setting.

b. Setting Carrier Oscillator Frequency

1. The accurate method is to use an audio generator as described previously, setting the generator frequency to 400 cps.

2. The high frequency setting may be made at either 1000 or 1500 cps, setting the relative power output as exactly full scale. The low frequency setting should read exactly half of full scale by adjusting C80 as described on Page 120. This adjustment sets the 400 cps audio frequency at the -6 db point on the filter, the carrier at the -25 db point.

10. Setting Sideband Frequency

This setting should be done as described in the construction manual.

11. Setting Sideband Balance Output

a. It is necessary to upset the carrier null setting in order to obtain enough RF output indication for this setting (always with audio gain control closed). This is done by rotating R118 and C9, if necessary.

b. Exact balance, as indicated by RF power output on the transmitter panel meter, is desirable even though an RF measurement at the center arm of R117 may not be equal in amplitude on both sidebands.

12. Final Carrier Null Setting

a. Most important in this setting is that both transmitter and receiver be thoroughly warm and at operating temperature.

b. Inasmuch as mechanical changes might take place when installing in the cabinet, always recheck null adjustment after this installation is complete.

c. If null drift should occur (after warm-up) C9 should be examined for evidence of mechanical instability. Replace, if necessary.

d. Carrier null should be rechecked every few months until components have fully aged.

13. Trap Tuning

a. Trap tuning of the 40, 20 and 15 meter traps can easily be accomplished by

tuning the transmitter to the exact frequencies indicated in the Chart on Page 121, then setting each trap to a minimum "S" meter reading on the receiver tuned to the frequency indicated. Shorten the receiver antenna again to obtain just full scale "S" meter reading at the transmitter output frequency (transmitter producing full output in the CW mode).

b. The 40 meter trap L19 is used to trap the second harmonic of the heterodyne oscillator signal operating at 3.4 mc. The trap is tuned for minimum receiver "S" meter reading with the receiver tuned to 6.8 mc. The transmitter should be tuned to 7.0 mc with full power being delivered to a dummy load (key down in the CW mode).

c. The 20 meter trap L20 is used to attenuate 9 mc energy passing through the heterodyne mixer at a low level. This trap is tuned for minimum receiver "S" meter reading with the receiver tuned to 14,150 kc. The transmitter should be tuned to 14,250 kc with full power being delivered to a dummy load (key down in the CW mode).

d. The 15 meter trap L29 is used to trap the 4th VFO harmonic on 15 meters at the VFO injection point. The trap is tuned for minimum receiver "S" meter reading with the receiver tuned to 21,100 kc. The transmitter should be tuned to 21,125 KC with full power being delivered to a dummy load (key down in the CW mode).

1. Any difficulty in getting these traps to tune may be traced directly to the trap in question...L19 is the 40 meter trap, L20 the 20 meter trap and L29 is the 15 meter trap. Examine each component, including the coil padding capacitor, wiring to BS2R and to the VFO mixer V7. Correct any error and proceed.

14. Setting ALC Meter Level

a. Setting this level should be simple. Any difficulty in making the setting can be traced to wiring of R113 (ALC set), harness lead to MS1R8, 9 and 10 (color code, 8 gray, 9 and 10 white-blue-blue) and meter terminals 3 (color code, white-blue-blue) and 9 (color code, white-orange).

15. Check of Relative Power Adjust Control

a. Any difficulty in the action of this control may be traced to terminal strip DC (Pictorial 5, Page 40).

b. Check connection to final tank coil L12, resistors R57 and R58, diode CR7, white-red-red lead at DC1 (exits at R114-1 on the front panel). Correct errors and recheck.

16. Setting FSK Frequency

a. If properly wired, adjusting C92 should change the FSK key closed transmitter frequency by an amount up to about 900 cps from the normal FSK key open frequency. If trouble is experienced here, check the following:

1. Wiring to MS4, lug 9 - exits one side of C92.

2. CR8/9 wiring from C92 to ground.

3. Resistor connections R92A, R92 and C150A.

4. White-violet lead to FSK key jack, lug 1.

17. Mode Switch Functions

a. The construction manual gives a mode switch operational check. If operation is normal, proceed; if not, examine color code leads from the harness to the mode switch as follows:

1. White-black-black to MS1F10.

2. White-violet to MS1F12.

3. White-blue-blue to MS1R9.

4. White-blue to MS1F2/4/5.

5. White-orange-orange to MS1R3.

6. White-yellow to MS1F9.

7. White-orange to MS1F6.

8. Black-blue shielded to MS36.

9. White to MS2-1.

10. Black to MS3-11.

11. White-yellow to MS4-2.

12. White-black to MS2-6.

Analyze specific malfunction by comparison with the described operation in order to localize difficulty.

1. CW
2. AM
3. FSK
4. LSB
5. USB

Check control functions at MS1F, MS1R, MS2, MS3F and MS4.

18. Function Switch Final Check

a. The construction manual gives a function switch operational check. If operation is normal, proceed; if not, examine color coded leads from the harness to switch as follows:

1. White-black-black to FS2-4.

2. White-gray-black to FS2-6.

3. White-yellow to FS1-6.

4. White-orange to FS1-3/5.

5. White-black to FS2-5.

6. White-orange-orange to FS1-12.

7. White-violet to FS1-11.

8. White-green to FS1-11.

9. White-blue to FS2-12.

Check jumper wiring to FS1 and FS2 from schematic. Correct any discrepancy and proceed.

19. Cabinet Installation

a. Most important before installing the transmitter in the cabinet is to route the cable harness in the rear corners away from the rear apron sheet metal screw holes. Prevent these screws from causing short circuits by positioning the harness clear of these areas.

b. Be sure to recheck the rear collars on shafts which may be binding due to springing of the front panel upon installation. VFO tuning, plate tuning and plate loading shaft collars may need repositioning.

c. Renull the carrier after installation and preferably after the transmitter has reached full operating temperature.

20. Operation

a. Meter readings:

1. Final grid current - scale reads 0 to 1 ma.

2. Final plate current, scale reads 0 to 400 ma (total cathode current of the final amplifiers).

3. ALC (ALC voltage) - white ALC area only.

4. Relative power - reads relative power output, adjustable with the Rel. Power Adj. control.

5. HV - final plate voltage - scale reads 0 to 1000 volts.

b. Note that in CW operation never more than 1/2 ma is required for maximum power. (Actually, in class AB1, power will begin to fall at about 1/8 ma of grid current-this is normal.)

c. Plate Tuning should always be done while observing the relative power output meter - the plate position is used only to check plate current and the evidence of neutralization. (A small plate current dip may be observed in CW ONLY when about 1/2 ma grid current is indicated.)

d. In AM, NO grid current is ever indicated since the drive level is reduced to allow only 100 ma of plate current in this mode.

1. 100% modulation is best observed on an oscilloscope, but may be closely approximated by increasing audio gain until the plate current just begins to vary slightly.

e. In SSB, the ALC circuit effectively keeps the grid current at zero. Only a slight movement of the grid current pointer should be observed (this condition holds as long as the ALC pointer stays within the white area of the ALC Box).

1. In SSB, plate current peaks never exceed 100 ma for full power output as observed on an oscilloscope.

2. In SSB, indicated relative power output (providing the relative power adjust control is left at the same point it was set upon CW tune-up) will always be about one-third that indicated in the CW mode. This is normal. Meter inertia is responsible for lack of reading and an oscilloscope trace will prove the point as illustrated in Figures 35A and 35B of the construction manual.

f. Spotting Level Function:

1. If your operating habits are such, you may like to check your frequency during a QSO. The SPOT LEVEL control may be left at a level which will give you a proper audio level in the receiver, if desired.

2. It is normal for the ALC pointer to kick up when changing from PTT-VOX to SPOT and vice-versa.

3. The driver tune control may be peaked while you are in the SPOT position and sustain an audio tone in the microphone, observing the "S" meter of your receiver for a maximum reading.

21. Supplementary Information

a. Shielding:

The HX-10 should not be operated nor should the coils be tuned with the metal cover removed. This cover provides the necessary shielding for stable operation.

b. Neutralization:

Important to neutralization is the proper placement of C146 (680 $\mu\mu$f) capacitor on the driver coil bracket and C40A (.01 μfd) capacitor on the VFO mixer coil bracket. Interchange of these two will result in inability to obtain grid drive and proper neutralization. The neutralizing capacitor C58 normally runs at about 50% when properly neutralized. Under no circumstances can neutralization be accomplished without grid current indication.

c. Loading:

Fixed 50 ohm loading is provided when the loading control is opposite the 50 ohm indication. When the transmitter is being used with 50 or 72 ohm transmission line, this control should be at or near the 50 ohm panel marking in the center of each band. This setting need not be changed when the transmitter is operated on a different frequency or band unless the antenna is such that a transmission line other than 50 to 72 ohms is used. The loading control may be tuned for maximum relative output power reading at any time. There will normally be small changes within a band and proper padding capacity is inserted when changing the bandswitch from one band to another.

d. Antenna SWR:

A standing wave indicating device is extremely useful. It may be used to tune the transmitter. Its readings in forward position should be the same as the transmitter relative output power readings. In the reverse position, it will indicate the SWR presented to your transmitter by your antenna.

The SWR should be below 2 to 1 for efficient power transfer. Higher readings indicate work on the antenna may be necessary. An SWR bridge may be left in the transmitter output line permanently.

e. Phone Patch Operation:

In this transmitter the phone patch and microphone input are in parallel. Many phone patches disconnect the audio signal when turned to their "OFF" or "STANDBY" position, similar to the Heathkit Model HD-19 Phone Patch. If your phone patch does not perform this function, it should be physically disconnected from the transmitter when not in use.

f. RTTY Operation:

The HX-10 should be tuned according to manual instructions for this service. In addition, it is usually necessary to advance the grid drive to a point where final amplifier plate current does not change with the shifting of the carrier frequency. Usually 1/8 to 1/4 ma of grid current will stabilize plate current. In any event, use the least amount of grid current to accomplish stable plate current indication.

g. Receiver Anti-Trip Connection:

Some receivers lack the 500 ohm audio output tap necessary for anti-trip operation. The anti-trip (500 ohm) lead from the accessory socket can be connected to the 4-8 ohm speaker terminal with fair results. Better results can be obtained by slightly modifying the receiver. A .01 μfd or .02 μfd capacitor rated at 500 volts can be connected to the plate of the receiver audio output tube. The other end of this capacitor may then be used as the 500 ohm or high impedance connection to the transmitter anti-trip control R110.

h. CW Operation:

1. When operating in CW mode with the tone amplifier connected to the receiver, remember to turn the anti-trip control counterclockwise since the energy fed to the anti-trip amplifier is capable of preventing relay K from closing, keeping the transmitter turned off.

2. When operating in the CW mode below 14,100 kc, and especially below 14,000 mc in the 20 meter band (if used on MARS frequencies), the transmitter should be operated at zero grid current. This will keep the spurious crossover frequency of 13,990 kc at or near -65 db. Operation at this level will not appreciably affect power output.

j. General:

Often in building a kit of this size the customer neglects the reading of the circuit descriptions provided. Your particular attention is invited to the block diagram and partial circuit descriptions. These will furnish you with a step-by-step explanation of the transmitter operation.

Too much emphasis cannot be placed on care used in placing components, dressing leads, and checking shielded cables for short circuits, as well as continuity. Observe in particular the soldering technique used.

Together with the schematic and circuit description, the "In Case Of Difficulty" section will furnish you with many ideas on working out any problems encountered.